SCIENCE

New Series
Vol. LXIV, No. 1655

Friday, September 17, 1926

Annual Subscription, $6.00
Single Copies, 15 Cts.

SCIENCE

Vol. LXIV September 17, 1926 No. 1655

CONTENTS

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. McKeen Cattell and published every Friday by

THE SCIENCE PRESS

Lancaster, Pa. Garrison, N. Y.

New York City: Grand Central Terminal.

Annual Subscription, $6.00. Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

Entered as second-class matter July 18, 1923, at the Post Office at Lancaster, Pa., under the Act of March 3, 1879.

JAMES HUTTON, THE PIONEER OF MODERN GEOLOGY[1]

Geology had its beginnings in ambitious attempts to solve by a single system of philosophy all the secrets of the physical universe, at a time when little was known and when it was the custom to evolve conceptions out of the workings of the inner consciousness rather than by reasoning from the facts of observation. It is, therefore, of the greatest significance that our civilization grew up within the most unstable belts upon the earth's surface, within which the awe-inspiring and catastrophic phenomena of nature draw attention to man's impotence in the face of these destructive manifestations.

From the outset religious beliefs have strongly colored the conceptions of natural phenomena. Earthquakes and volcanic eruptions, devastating floods of waters and plagues of insects have one and all been looked upon as indications of the displeasure of some deity. The Christian era inherited both from the pagan world and from the Hebrew conceptions of the Old Testament the idea of punishment through the infliction of destructive geological phenomena.

Under these circumstances it was but natural that the church should have been looked upon as the fountain of all wisdom in matters scientific as well as spiritual, the more so since the intellectual class of the middle ages was restricted to the churchmen and to the physicians, who were usually closely attached to the persons of powerful Christian princes on whom they were dependent for their support. The records of ideas were, moreover, treasured in the monasteries of the church. Little wonder is it, therefore, that reasoning from the facts of observation was so long in usurping the place of the inherited conceptions over which the church had spread the protecting cloak of divine revelation.

Science has been inclined to ascribe an emancipation from church dictation to the controversy which developed near the middle of the last century over Darwin's "Origin of Species," but evidence is not wanting that within large sections of our own country its shackles are still upon the popular beliefs.

There were certain fundamental problems of geology on which the church had made no very definite pronouncement, and it was in this supposedly safe quarter where no affront would be offered to church

[1] Read at the Memorial Meeting of the University of Michigan Research Club on April 21, 1926.

dogmas that modern geology grew up and obtained a certain amount of support before its more independent leaders were called upon to measure swords with the champions of the church. The problem of the origin of rocks it was at first sought to solve in such a manner as to cover by a single process all rocks of whatever sort. Two schools soon grew up—the Neptunists, who ascribed all to the action of water, and the Vulcanists, who made the action of fire explain everything.

The leader of the Neptunists was a very remarkable personality, Abraham Gotlob Werner, teacher of mining and mineralogy at the Mining Academy of Freiberg in Saxony during the last quarter of the eighteenth century and the first quarter of the nineteenth. The recognized head of the rival school, though he did not really ascribe the origin of all rocks to the action of fire, was James Hutton, of Edinburgh. In the controversy for which Werner was so largely responsible, neither he nor Hutton took a very active part, the fight having been waged with great bitterness by the disciples or the admirers of these leaders. To evaluate the service to science of James Hutton it is necessary at the outset to study the personality of his rival. Werner was in no sense an observer and he had never been outside the little province of Saxony in which he was born. His quite remarkable influence upon the thought of his time must be ascribed to his engaging but dominating personality and to his quite remarkable power as a lecturer. Not only the young men, but those also who had already arrived at distinction, traveled to Freiberg and learned the German language in order that they might listen to the lectures of this great expounder of popular doctrines. Captivated by his personality and power they went to their homes as his apostles fired with all the zeal of Jesuit missionaries to propagate the faith of their idolized master.

Werner's lectures traversed every field of human interest. His mineral specimens he would connect up in his lectures with the migrations of races, with the development of the arts, with campaigns, battles and military strategy. The artist, politician, historian, physician and soldier were each shown how mineralogy was altogether indispensable to them in their professions. Sir Archibald Geikie has said of Werner: "It seemed as if the most efficient training for the affairs of life were obtainable only at the Mining School of Freiberg. . . . No teacher of geological science either before or since has approached Werner in the extent of his personal influence or in the breadth of his contemporary fame."

Of the great geologists of the day who received their inspiration from Werner were von Humboldt, von Buch, Cuvier, d'Aubuisson, Freisleben, Karsten and Jameson. Yet it was from among this distinguished group of his students who had fallen under the master's spell that many of Werner's doctrines were destined later to be completely repudiated; for there can be no doubt whatever that the evolution of scientific thought was set back by decades through the influence of Werner's hypnotic teachings. "Never," says Sir Archibald Geikie, "was a system devised in which theory was more rampant; and theory, too, unsupported by observations, and, as we now know, utterly erroneous. From beginning to end of Werner's method and its applications, assumptions were made for which there was no ground, and these assumptions were treated as demonstrable facts. The very point to be proved was taken for granted, and the geognosts, who boasted of their avoidance of speculation, were in reality among the most hopelessly speculative of all the generations that had tried to solve the problem of the theory of the earth."

In Great Britain the Wernerian School gained headway because the doctrine of a universal ocean within which the rocks had been precipitated from solution was made to fit to the dogmas of the church through connecting up the latest inundation with the Noachian deluge. This rallied the church to its support at a time when heresy-hunting had been greatly stimulated by the French Revolution, and nowhere more than in Scotland, where Robert Jameson, one of the most distinguished of Werner's British pupils, was the professor of natural history in the University of Edinburgh. Jameson in his writings asked the pertinent question, "What has since become of the immense volume of water that once covered and stood so high over the whole earth?" And with true Wernerian faith he answered it himself. "Although," he said, "we cannot give any very satisfactory answer to this question, it is evident that the theory of diminution of the water remains equally probable. We may be fully convinced of its truth, and are so, although we may not be able to explain it. To know from observation that a great phenomenon took place is a very different thing from ascertaining how it happened." Commenting upon this, Geikie remarks: "I do not suppose that in the whole literature of science a better illustration could be found of the advice—'When you meet with an insuperable difficulty, look it squarely in the face—and pass on.'"

The Wernerian doctrines did not alone hold sway at the great Scottish university; Sedgwick, at Cambridge, and Buckland, at Oxford, were Church of England clergymen, as were other prominent naturalists of the day, such as Conybeare, Whewell and Henslow. The Geological Society of London, which was founded at this time, was so dominated by the Neptunists that it was in effect a second Wernerian

institution, a so-called Wernerian Society having already been started at Edinburgh for the purpose of propagating the Neptunist doctrines.

Specifically, the battle came to rage most bitterly over the origin of basalt, which according to the Wernerian dogma was, in common with all rocks, a chemical precipitate from the ocean; though it is now known to be always formed by cooling and consequent consolidation of a molten mass.

It is against this background of authority by dogma that the figure of James Hutton is projected late in the eighteenth century. Born at Edinburgh on June 3, 1826, the son of a worthy citizen who had held the office of city treasurer, Hutton received a high-school education, and though already interested in chemistry, at the age of seventeen he chose the profession of the law. After a year of drudgery as apprentice in a lawyer's office, he shifted to medicine, and for three years he prosecuted his medical studies at Edinburgh. As was then the custom, he completed his studies upon the continent, remaining nearly two years in Paris, where he studied chemistry and anatomy. At Leyden in Holland he received the degree of doctor of medicine in 1749.

Having already abandoned the law, his first choice of a profession, he now lost his interest in medicine so soon as he came to enter upon its practice. This appears to have been due at least in part to the success of some chemical researches of a practical sort begun with a friend on the manufacture of sal ammoniac. However, before these studies had reached the stage of commercial success, Hutton had resolved to apply himself to farming. In 1752 he went to Norfolk in East Anglia to live with and study the methods of a farmer, and now in the rural sports and in the little adventures of his host, he entered with great zeal. It was on excursions in and about Norfolk that his mind first turned to mineralogy, as geology was then called. He entered with great interest also into his farming studies, and after two years at it made a tour to Flanders to study farming methods there, after which he settled down upon his own family inheritance in Berwickshire. For fourteen years beginning in 1754 he was buried in his rural pursuits at this homestead, only occasionally visiting Edinburgh. The sal ammoniac process had by this time proved a success and he became in 1765 a regular copartner in the manufacture of it so as to become fairly independent. Having now his farm well regulated, in 1768 at the age of forty-two he removed to Edinburgh to devote himself entirely to scientific studies.

In the Scottish capital he found many friends and was at once received into the most select society. One of his most intimate friends was Dr. Joseph Black, the great chemist who had made the discovery of carbonic acid. Another of his closest friends was John Clerk, of Eldin, known as the author of a work on naval tactics and as the inventor of the method for breaking the enemy's line at sea which led to so many naval victories by Great Britain. Other intimate friends were Sir James Hall, the pioneer in experimentation in geology, and John Playfair, the well-known mathematician and philosopher.

Playfair's relation to Hutton came to be very much the same as that which later developed between Huxley and Darwin. Hutton, like Darwin, was without the gift of a clear and forceful literary expression; Playfair, like Huxley, possessed this gift in a high degree, though he lacked the trenchant quality which belonged to Huxley's style, and he was without the aggressive, not to say pugnacious, manner which was so effective in Huxley. Like Huxley, however, Playfair essayed to be the interpreter for his heavy but profound colleague and friend. Playfair's remarkable book, "Illustrations of the Huttonian Theory of the Earth," which was written after Hutton's death, is delightful reading even to-day, in spite of the antique s's.

The doctrines alluringly set forth by Playfair were first presented by Hutton in 1785 before the Royal Society of Edinburgh at one of its early meetings, and the paper was printed in the initial volume of the Society's "Transactions." In expanded form, but still incomplete, it was published in 1795 in two octavo volumes under the title, "Theory of the Earth, with Proofs and Illustrations," and a third volume was left in manuscript when Hutton died. There is some doubt whether a fourth volume was in part written and has been lost. The manuscript of the third volume, which has been preserved in the library of the Geological Society of London, was in 1899 edited with great skill by the late Sir Archibald Geikie and published in that year. Like the "Origin of Species," Hutton's work was a vast storehouse of careful observations, but it lacked good summaries to set forth the principles which were derived. The third volume of the work and the "Illustrations" by Playfair constitute the material on the basis of which Hutton is best known to geologists to-day.

Though he antedated Darwin by almost three quarters of a century, Hutton's work is characterized by the same painstaking care and thoroughness of observation. It would thus be diffcult to conceive of a greater contrast than Hutton supplied to the brilliant Werner, whose fame had drawn disciples from every country of Europe, but whose views have one after the other been repudiated as their fallacy has been proven by the facts of observation. It was Hutton's practice to go direct to nature in order to discover

the facts. On the basis of these facts he then sought to lay down the principles of a science which was soon to become known as geology, though Werner had already promulgated the name geognosy and referred to his disciples as geognosts.

By many observations Hutton was able to prove conclusively that granite and basalt were not precipitated, as Werner supposed, from the ocean, but were both formed as the result of the cooling of a molten mass. Sir Charles Lyell has said of Hutton's "Theory of the Earth":

> This treatise was the first in which geology was declared to be in no way concerned about questions as to the origin of things, the first in which an attempt was made to dispense entirely with all hypothetical causes, and to explain the former changes of the earth's crust by reference exclusively to natural agents.

Elsewhere he wrote, "Hutton laboured to give fixed principles to geology as Newton had succeeded in doing for astronomy."

Hutton was not actually the first to derive all the ideas which he promulgated. Guettard, a French contemporary of Hutton, who completed his geological studies somewhat earlier, proved conclusively that most of what we now know as the volcanic rocks of Central France had been produced by the cooling of a molten mass. Of the basalt of the region the relations were not by any means so clearly indicated, and this rock Guettard erroneously explained as a precipitate from water, a view in harmony with the later Wernerian doctrine. Guettard may therefore be regarded as in the anomalous position of being the founder of both the rival schools of the Vulcanists and Neptunists. Like Hutton he was not gifted with powers of exposition, but wrote ponderous technical volumes. It has even been said of him that he buried his reputation under the weight of material which he left to support it. Guettard's error concerning the origin of the French basalt was corrected by his contemporary, Desmarest, who, quite as much as Guettard and Hutton, went to nature for his facts.

But to return to Hutton, his "Theory of the Earth" in spite of all its defects of exposition has been declared by von Zittel, the distinguished paleontologist and historian of geology, to be "one of the masterpieces in the history of geology." Notwithstanding this, there is no fact more certain than that it failed utterly to recommend itself in his own day for general acceptance, and the scientific world was forced to wait another half century until much the same ideas alluringly and tactfully set forth by Sir Charles Lyell brought a revolution in the science and laid the cornerstones of the modern edifice.

Both in his study of the rocks themselves and of the shaping of the surface features of the earth, Hutton proved that processes like those still in operation were entirely competent to account for all the facts of observation. This he expressed in the now oft-quoted sentence, "In the economy of the world I can find no traces of a beginning, no prospect of an end," which was coupled with the doctrine that all past changes on the earth have been brought about by the slow action of existing causes. Here we find the fundamental idea of the doctrine of evolution—continuity as opposed to interruptions—a doctrine now often described for the inorganic world as uniformitarianism. "Consistent uniformitarianism," wrote Huxley in 1887, "postulates evolution as much in the organic as the inorganic world."

The conception of evolution thus arrived for the inorganic world a full three quarters of a century before it was promulgated by Darwin for the realm of the organic. Lyell's motto paraphrasing Hutton's slogan above cited was "the present is the key to the past," and this he had extracted from Playfair's "Illustrations."

The *idea* of continuity or evolution in nature was, of course, much older than either Hutton or Darwin, for it is to be found well expressed in Lucretius and it was revived by Generelli, an Italian Carmelite friar of the sixteenth century; but it was Hutton who first found the proof of the doctrine in the facts of observation. Professor Judd has related that in 1871 Matthew Arnold laughingly remarked to him, "I can not understand why you scientific people make such a fuss about Darwin. Why, it's all in Lucretius!" "Yes," retorted Judd, "Lucretius guessed what Darwin proved."

But the first chapter of Genesis, which sets forth in allegory the creation of the inorganic and organic worlds, recites sudden creations at definite times, not a continuous growth by slowly operating forces, and on the continent of Europe the authority of the great Cuvier was given to the idea of great catastrophes which had punctuated earth-history, bringing with them destruction of organic forms and creation of new species. Hutton was soon charged with heresy for bringing out ideas which were contrary to the Scriptures. Kirwan, de Luc and Williams, all zealous geologists of the Wernerian School, declared Hutton to be an enemy of religion. Sedgwick, at Cambridge, eloquently declaimed against the unscriptural tenets of the Huttonians. Conybeare, in his "Outlines of the Geology of England and Wales," speaks of the wildness of Hutton's views, and adds: "He who could perceive in geology nothing but the ordinary operation of actual causes, carried on in the same manner through infinite ages, without the trace of a beginning or the prospect of an end, must have surveyed them through the medium of a preconceived hypothesis alone."

The city of Edinburgh, where Hutton made his home, was the stronghold of the Presbyterians and Calvinists, and it was in such an atmosphere a simple matter to blacken Hutton's reputation. "Britain," says Judd, "which had produced the great philosopher, Hutton, had now become the center of the bitterest opposition to his teachings."

Hutton died in 1797 without having been able to convince his contemporaries of the truth of the principles he had laid down; but in the very year of his death two men were born, Paulett Scrope and Charles Lyell, who were destined to establish the Huttonian doctrines as the foundation stones of modern geology. The greater of them, Sir Charles Lyell, possessed just those gifts which Hutton lacked. By a forceful and lucid literary expression and a diplomacy and tactfulness in dealing with those questions which were in conflict with church dogma, he succeeded completely where Hutton had utterly failed. Somewhat unfairly, Lyell wrote of Hutton—and throughout he has given less than due credit to his distinguished predecessor—"I think he ran unnecessarily counter to the feelings and prejudices of the age. This is not courage or manliness in the cause of Truth, nor does it promote progress. It is an unfeeling disregard for the weakness of human nature, for it *is* our nature (for what reason heaven knows) . . ." Lyell himself was most careful to avoid a frontal attack upon the citadel of the church. He preferred unobtrusively to sap and mine, and he did this with a success of which geologists are now well aware, and by so doing he reaped rewards which might have come to the pioneer, Hutton.

Those who are intimately familiar with the fierce controversy which raged in England over the appearance of the "Origin of Species" will remember that though Lyell was on terms of intimacy with the great figures in the controversy on the Darwin side—Darwin himself, Huxley, Wallace, Hooker and Spencer—he yet was careful to refrain from any public expression likely to bring himself into conflict with the church.

It has generally been supposed that Lyell derived his views as expressed in his "Principles" directly from Hutton's writings, though this has been disputed by Judd, who claims they were developed from Lyell's own studies and that later when he read Hutton's book and the Playfair "Illustrations" he was greatly impressed by the proofs of genius in the great Scottish philosopher.

To-day the place of James Hutton is secure among the great founders of geology, and he stands out from the others as the hardy pioneer who endured the hardships and took the hard knocks and thereby paved the way for the new era in geological science. He was the first to prove the truth of the doctrine of continuity or evolution within the inorganic realm of nature, as Darwin was in the organic. That Hutton was not acclaimed for his work while he lived probably caused him little concern. He seemed to be content to have the good opinion of the great men associated with him—those who knew his work intimately and whose esteem was, therefore, precious to him. Their opinion is shared to-day by all geologists who have carefully studied the history of their science.

WM. H. HOBBS

UNIVERSITY OF MICHIGAN

COOPERATIVE RESEARCH—THE PLAN OF THE NATIONAL TUBERCULOSIS ASSOCIATION

I

THE necessity for progress in medical research in tuberculosis has been recognized since the first presidential address by the great American pioneer, Edward L. Trudeau. In the natural course of events the urgency for organization and education held research work in abeyance during the first fifteen years of the association's existence, even though its importance was emphasized from time to time. This abeyance of activity was justified by the fact that there had been devised no sure method for the expenditure of money for the development of research. Methods had been tried by foundations and other interested bodies, but had not proved sufficient in production to merit the expenditure.

While the association was anxious to increase its knowledge through research work, its funds were so limited that it was not warranted in making use of them for research unless a way was offered which insured a certain measure of success.

II

In 1920, at the suggestion of Dr. Charles J. Hatfield, at that time managing director, the president, Dr. Gerald Webb, appointed a small committee to study the question of research in tuberculosis and, if possible, to offer to the executive committee of the association a plan for its development that promised success and that would require only the limited sums of money available. This committee was composed of Dr. William Charles White (chairman), Dr. Paul A. Lewis and Dr. Allen K. Krause.

III

One year was spent by the committee in the study of this problem. Surveys were made (1) of research facilities in the tuberculosis hospitals and their labo-

ratories and in research laboratories in general; (2) of the funds that were available, not only for tuberculosis research, but for all scientific research and of the way in which these were used; (3) of the methods employed by other institutions to stimulate research; (4) of the progress that had been made in tuberculosis research and in other fields of scientific research.

IV

The result of this study led the committee to several fundamental conclusions. It decided that the first necessity was the choice of specific problems. This meant a study of the evolution of research in tuberculosis, a decision as to the most important problems yet unsolved, and a determination of the most hopeful leads toward the goal which the association had set for itself. (This goal was, primarily, the relief of those sick with tuberculosis, although phases connected with prevention and with animal industry were also serious matters.) Determination of problems thus was found to be the most important function of the committee, and a clear outline of certain specifications for each problem was required before the committee could take further steps.

Once these had been defined, the next fundamental step was the choice of that man or woman whose knowledge and technique was most likely to insure success in the solution of such a problem.

After the research worker had been chosen, it was next necessary to devise some way to induce him to undertake the solution of the problem so as not to interfere with progress in his own field.

V

It was obvious from the beginning that the best research workers were not to be found to-day in the laboratories attached to sanatoria: these laboratories had become sterile as a factor in research simply because the sanatoria had been developed in isolated places and along lines which made administration and care of the sick the chief duties. It was evident, on the other hand, that in the laboratories connected with our great universities the facilities for research were most abundant. Here the spirit of research had been kept alive, and a constant supply of new workers were advancing through the years of a university career to follow in the footsteps of those who preceded them and to add to the knowledge already gathered. The men in charge of these laboratories were trained in research and its technique and direction. It was but a step to the conclusion that, the problems once determined upon, there was greater chance of success in their solution if the men in these university laboratories could be induced to undertake the task, for they had all the natural research facilities. But in these laboratories the spirit of so-called pure research was in the ascendency, and it was necessary to prove to the research workers there that their methods and principles could be worked out on a specific problem of economic importance just as well as on a problem which was of less economic interest.

In carrying out the details of such a plan the committee soon determined that no money should be invested save where the published work indicated that the research worker chosen was the best fitted in initiative and knowledge to undertake the study. In other words, it was decided to invest in brains only.

VI

Shortly after its appointment it was suggested to the committee that the most likely way to proceed was to establish a national institution for tuberculosis research on a plan often followed in this country and in Europe. But to provide such an institution was out of the question, as the funds of the association were not available for such a project. This compelled thought along other lines. Already there were institutes, such as the Henry Phipps Institute for the Study and Prevention of Tuberculosis at Philadelphia and the Edward L. Trudeau Foundation for Research and Teaching in Tuberculosis at Saranac Lake which could function as national institutes to provide housing for researches that should temporarily be together for more intimate work, since the sympathy and guidance of those in charge were part of the national program.

It was also evident that the institute plan had disadvantages. It interfered at times with the research worker. It often uprooted him from his environment, from the place where his work had developed; it lost for him his line of advancement and brought him into unfamiliar surroundings; it caused loss of time during the change and it did not guarantee success in the new environment. Further than this it made the institute responsible for his future. So in the natural course of thought the plan here described evolved, which permits the research worker to remain in his own environment; allows him to pursue the problem which he is asked to undertake in familiar surroundings and with no loss of time.

But this was not enough. Such a worker must come in contact with workers in allied fields, both for the sake of correlation of results and for the stimulus and addition to knowledge which such a contact would supply. For this purpose a counsellor or jury system was devised.[1]

At the end of the first year an outline of the plan described here was laid before the executive committee of the association, with the result that an allot-

[1] See Section IX.

ment was made in the next budget of the association for medical research. Although the details of the plan were not yet completed, it was felt that it was in such shape as to justify such an appropriation and an initiation of active work.

VII

It was essential that the committee be small, not only that it might meet with ease, but because its members were required to study constantly the past and current literature in the special field of tuberculosis research and general research, in order that the committee could appreciate every significant fact bearing upon its task and could choose well the man or woman best fitted to undertake its problems. It must be able to talk the language of the workers whom it desired to induce to solve its problems. It must be cognizant with all phases of science allied to the immediate question, so that it could suggest, wisely, ways to attack any given research. It must be able to retain the interest of the worker when once aroused and, finally, and most important, it must be able to correlate the results of its different researches and bring associated researches into conjunction with each other. If it was to be a success untiring study must be its program.

There are times, however, when the committee must efface itself and the officers of the association take up the activity. Such a circumstance arises after the research committee has decided upon a problem, has chosen the research worker and has induced him to accept it. When these preliminaries have been attended to by the Research Committee the president of the National Tuberculosis Association must write to the president and trustees of the university where the research is to be carried on, tell him what is desired, announce the grant and ask in return that the research worker be relieved as much as possible from teaching duties so that he may pursue his research more rapidly. This is an important duty, for the care and dignity with which it is done means much to the spirit with which the work is carried on.

VIII

A grant provides for assistants, technicians, money for publications of results, scholarships and necessary equipment. It provides also for expenses for the research worker when he must travel in order to meet in conference with his confrères. None of it goes to him personally. His return comes only in the privilege of following his problem in research with greater ease and in having his position enhanced in his university by national recognition.

When a grant is accepted, a revolving fund is placed with the treasurer of the university where the research operates. On the first of each succeeding month, against his account, receipted bills, signed by the recipient of the money, approved by the research fellow and the treasurer of the university, are sent to the chairman of the research committee for approval. In his office the expenditures are examined and, if correct, the bills are forwarded to the executive offices of the association for payment to the university, reimbursing it up to the amount of the original deposit. In this way records of the purchase of permanent equipment are kept and, in the event of the completion of a particular piece of work, such permanent equipment can be moved to the service of another research worker. The status of each grant is likewise controlled and notices are sent out if irregularity appears. It is generally necessary at the opening of a grant for a member of the committee to hold a conference with the treasurer or comptroller of the university, in order to adjust the university accounting system to conform with that of the association.

IX

It was soon found desirable and necessary to have the help of a broader critical knowledge than that represented on the committee, both for discussion of the specific problems and to make sure that the researches chosen for study were sound. To accomplish this a counsellor or jury system was developed. The association, through its committee, invites a body of experts in a given field of research to listen to a presentation of the research work pursued by different workers in allied fields under grant from the association. At a jury meeting is presented the plan of attack, the present status of knowledge, the course and probable outcome of the study in each research, and then the counsellors are asked for frank criticisms and suggestive advice. These meetings have at times meant revolution in the plan of study and always have added a great deal to the success of the plan. They have provided opportunity, quite essential, for the correlation of existent knowledge and education of individual students in other fields of research.

The National Tuberculosis Association, organized as it is for the public welfare, receives an unusually generous response from those who are best qualified by knowledge and experience to offer constructive criticism and who would not be willing to give the time save where the spirit of altruism and the love of mankind prevailed.

X

To establish further correlation of research work the members of the committee find it advisable to go to the several laboratories where research under

it is carried on and, wherever possible, to assist the progress of the individual research by reporting the information gained in other laboratories.

The association has found, at its annual meeting and its different sectional meetings, that the presentation, in symposium form, of the progress of its several researches has greatly enhanced the interest of its members in the new knowledge available from time to time. It has often invited those concerned with the same type of work, even though not members of the association, to take part in these discussions. In this way it has focused more of the attention of the association upon the field of scientific research and enabled it to recover, in a measure, from the dominance of its educational program.

XI

Very early in the execution of such a plan by a voluntary organization it was necessary to try and secure the interest and guidance of more permanent agencies responsible for tuberculosis as a disease. The United States Public Health Service includes tuberculosis as one of its problems and is in touch with the various state health departments and laboratories. The Bureau of Animal Industry handles the whole question of cattle tuberculosis and tuberculosis in other animals. These two bureaus also serve as the government powers in licensing biological products, such as tuberculin, for diagnostic and therapeutic use.

In addition, there are the manufacturing chemists who prepare and sell biological products and come into direct contact with all health agencies through this distribution.

Also, two great business interests benefit tremendously by progress of knowledge in this field and are factors of importance. One is the cattle industry, with its branches of farmers, stock-breeders, packers, slaughter houses, etc., and the other, the insurance companies, whose annual loss from tuberculosis among its policy holders is one great cause of the high cost of insurance.

Both federal bureaus have been generous in lending their advice and cooperation. The chairman of the research committee is the officer in charge of tuberculosis research at the hygienic laboratory, which makes it the clearing house for all the research work under the national association. The manufacturing houses, too, have welcomed the opportunity to be of assistance in this matter of public health, employing their plants whenever possible to aid in bulk production of substances or in other ways.

Several attempts have been made to interest the cattle industry and the life insurance companies, but so far they have taken no part in this work of the association.

With the present cooperation and guidance of the United States Public Health Service and of the Bureau of Animal Industry, any advance in knowledge can be rapidly disseminated to the whole interested public, such as health officer, physicians, nurses, etc.

XII

One example in illustration of the working of this machinery of cooperative research may be cited to make its work clearer. In the department of chemistry there has been developed a wholly new method of bacterial-chemical analysis. Each new substance isolated by this department is sent to the research committee and by it distributed to other laboratories for biological study in the field of cytology, serology, physiology and bacteriology. In no one laboratory are there the experts who can do all this work. The reports of these individual studies are returned to the committee and are made the bases of the lines of future research.

XIII

Finally, it is necessary to supplement the pure research work with clinical studies in the sanatoria where those sick with tuberculosis are segregated. The sanatoria have been grouped in relation to the university centers, and plans have been completed to man the laboratories of the sanatoria with research students from the university laboratories, giving them definite problems to work out under the direction and help of the chief of research in the university laboratory.

A research problem for each is defined and fitted to the machinery of the sanatorium where it is to be carried on. Opportunities are made for careful supervision and reporting of the results to the research director.

In order to obtain the necessary contact with the sanatoria, a new clinical research committee has been appointed by the American Sanatorium Association, which will oversee, in cooperation with the research committee of the National Tuberculosis Association, such clinical study as is undertaken in this way. It is hoped that this clinical research will be of value further in testing substances offered for alleviation of those that are sick with tuberculosis, and thus save the suffering which follows the premature distribution of such products, as well as in assisting the federal bureaus in their duty of licensing such substances.

This plan of cooperative research inaugurated by the National Tuberculosis Association has been in operation now for five years. It came as a recognition of the fact that knowledge has increased beyond the capacity of a single brain and that, therefore, progress was more likely to follow some method of

group activity. That brilliant discoveries occur in isolated work is not forgotten, but it is remembered that they are always based on the correlation of past efforts. As a practical method of utilizing the facilities of the country for progress in research, the plan has met with unlooked-for success, although it is still in an evolutionary stage and has, daily, difficult problems to meet. It offers a machinery which makes use of existing research opportunities and which yet fits in perfectly with the present operation of society as represented by the universities and other institutions. As a result of its five-years' work interest in tuberculosis research has grown to proportions such as would not have happened in the same length of time without the stimulus supplied by the grants from the association. It has not only advanced our knowledge, but in some measure completely changed our conception of this disease.[2]

XIV

More money than is now available could be used with enormous advantage to the whole research. New studies defined in the committee's program are immediately urgent, and if not actively in operation will delay the progress of the whole study. The students have been chosen to do the work, but no step can be taken until the money is forthcoming. Loss of interest only can result from approaching a research worker unless the committee is prepared to go ahead and carry through the project.

In closing, it is essential to the success of the association plan to have: (1) A small committee so constructed that it shall have time to study the progress and literature of the whole field of science: watch for development in any field that may help the solution of the tuberculosis question: define clearly its problems: interest those best fitted to undertake each research it desires to have studied; correlate the results: outline future advances: stimulate interest and cooperation among individual research workers: secure the cooperation of other bodies and institutions whose interest is necessary to complete the work. (2) A spirit within the whole association which will justify it in asking and enable it to receive the criticism and guidance of those qualified to assist the work of the committee. (3) A plan of accounting which will insure constant supervision of the use of its funds. (4) A machinery which will use, in its attack upon the tuberculosis menace, existent facilities for research, directors of research, hospitals, students, and laboratories, and which will fit into the present operation of our social organization. (5) An institute such as the Phipps Institute at Philadelphia where more closely knit researches can be pursued, if, in the course of the work it is deemed necessary to bring into closer contact one or more of the workers whose problems are allied. The workers, under this plan, would be only borrowed for a time in order to finish a task, and would not therefore lose any of their own academic position.

This plan as it has been outlined allows the association to conduct its research very economically: it provides little overhead expense but does enhance the status of the research worker taking part in its program. It adapts itself to the conditions encountered, and at the same time accomplishes its purpose through the medium of trained skill and science.

WILLIAM CHARLES WHITE

U. S. PUBLIC HEALTH SERVICE

[2] The work undertaken so far under this plan has to do with the fixing of standards such as a base line for living bacterial chemistry, a base line for living cell chemistry, anatomical factors in the spread of lung infections, standards for X-ray pictures of normal lungs and similar problems so that published work from research in this field will be comparable and truths more quickly reached by the delineation of the laws underlying the processes involved. There have been published under the grants of this committee sixty-five papers in fourteen journals, a list of which may be obtained from Dr. Linsly R. Williams, National Tuberculosis Association, 370 Seventh Avenue, New York City.

THE THIRD PAN-PACIFIC SCIENCE CONGRESS

A SECOND announcement concerning the Third Pan-Pacific Science Congress, which will be held in Tokyo this fall, has recently been issued by the National Research Council of Japan and gives additional information concerning the congress in extension of that published in SCIENCE for July 24, 1925.

The period for the scientific sessions of the congress will extend from Saturday, October 30, to Thursday, November 11. Excursions have been arranged for those attending the congress and will occupy a number of days both preceding and following the scientific sessions. The excursions will include trips to Hokkaido, October 18 to 25; to Nikko and Hakone, October 26 to 29, and to Kyoto, Nara, Osaka and Kobe, November 12 to 15, and to Miyajima and Kyushu or Shikoku, November 16 to 19. These trips will make it possible for the members of the congress to see parts of Japan which are noted for their scenic and historic interest and also a number of regions of particular scientific significance, such as the Ainu villages of Hokkaido, geologic and mineral deposits of importance and localities of special volcanic activity.

The announcement continues as follows in regard to the tentative scientific programs:

The scientific programs will, for the most part, be arranged in the form of symposia upon selected subjects. These subjects are given below, and, with the exception of the first two selected for discussion at joint divisional meetings, they will ultimately be so arranged that some will be discussed at physical divisional meetings, others at biological divisional meetings, and still others at sectional meetings. The final form which scientific programs will take depends largely upon what contributions will actually be made.

SUBJECTS SELECTED FOR DISCUSSION AT JOINT DIVISIONAL MEETINGS

(1) Symposium on certain definite plans for international cooperation in the study of the more important scientific problems of the Pacific.

(2) Review of the present state of knowledge of the physical and biological oceanography of the Pacific: tides and currents, temperature, salinity, hydrogen-ion concentration, abundance of plankton, duration of the swimming larval stages of organisms that are sedentary in the adult stage, etc.

SUBJECTS SELECTED FOR DISCUSSION AT EITHER DIVISIONAL OR SECTIONAL MEETINGS

(Physical Sciences)

(3) Astronomical observations especially connected with the Pacific region.

(4) Solar activity in relation to geophysical problems of the Pacific region.

(5) Distribution of terrestrial magnetism in the Pacific region.

(6) Meteorological study of the Pacific region: general circulation of the atmosphere, cyclones and correlation of meteorological elements.

(7) Meteorological and time service by radio-transmission in the Pacific region and causes which give rise to its disturbances.

(8) Form of the geoid in the Pacific region as deduced from geodetic observations, measurements of gravity or plumb-line deviation.

(9) Suitable map projections for maps on different scales for the countries bordering on the Pacific.

(10) Difference of the attenuation of radio waves along and across the meridian of the earth in the Pacific region.

(11) Crustal movements and geotectonics in the Pacific region: earthquakes, crust tides, variation of mean sea-level, etc.

(12) Report on the network of earthquake observations in the countries of the Pacific.

(13) Transmission of earthquake waves across the Pacific.

(14) Earthquake-proof constructions.

(15) Study of volcanoes in the Pacific region in their various aspects.

(16) Thermal springs in the Pacific region.

(17) Correlation of the Mesozoic formations of the Pacific region.

(18) Boundaries of the Pliocene and Pleistocene deposits in the Pacific region.

(19) History of the strandline of the Pacific during Pleistocene and Post-Pleistocene time.

(20) Metallogenetic epochs of the Pacific region and their bearing upon its structural unity.

(21) Stratigraphy of the coal-bearing formations in the Pacific region.

(22) Stratigraphy of the oil-bearing formations in the Pacific region.

(23) Mineral resources of the Pacific region: coal, petroleum, sulphur, phosphate of lime and useful metals.

(24) Distribution of rare elements in the Pacific region.

(25) The present and future trade connections among the countries bordering on the Pacific from an economic-geographical point of view.

(Biological Sciences)

(26) Interrelationship of the floras of Pacific regions as indicated by the distribution of certain groups of land and marine plants.

(27) Flora and fauna of the islands of the Pacific, with special reference to the problems of endemism and migration.

(28) Rational methods for the protection of useful aquatic animals and plants of the Pacific.

(29) Genetics in relation to the improvement of important crops, more particularly rice, and of live stock.

(30) Information regarding the insect faunas of the Pacific region, especially those affecting economic plants and animals.

(31) Distribution of bonitos and tunnies in the Pacific and their ecological studies.

(32) Distribution and life-history of the fresh water eels in the Pacific region.

(33) International cooperation in the investigations of pelagic fish eggs and larvae.

(34) Preservation of natural monuments in the Pacific region.

(35) Different plant successions as observed in various regions of the Pacific.

(36) Ecology of the epiphytic flora in the Pacific region.

(37) Origin and development of vegetation on the newer and older volcanic deposits in the Pacific region.

(38) Distribution of volcanic ashes in the Pacific region and their physical and chemical properties, with especial reference to their agricultural value.

(39) Rational methods of storing cereals.

(40) Use of green manures in various Pacific regions.

(41) Methods of soil classification and soil surveying.

(42) Citrus culture in the Pacific region.

(43) Scientific bases for plant quarantine in the countries of the Pacific.

(44) Control and treatment of the infectious and parasitic diseases of live stock.

(45) Antiquity of man in the Pacific region.

(46) Anthropometry of the races of the Pacific region.

(47) The Ainu people: their origin and affinities with other peoples.

(48) The place of the Papuans in the anthropological system.

(49) The pygmy question, more especially relating to New Guinea and the Philippines.

(50) Cultural developments in the East Indies and the theories of the "Kultur-historische" and the "Manchester" schools of social anthropology, regarding the evolution of culture in the Pacific.

(51) Food, clothing and dwelling houses in relation to climate in the different regions of the Pacific.

(52) Distribution, prevention and cure of particular diseases among native races of the Pacific region.

(53) *Ascaris, Anchylostoma* (*Necator*) and *Schistosoma:* distribution, life-history, clinical aspects, prevention and treatment.

One of the principal matters to be considered on this occasion will be the formation of a permanent or continuing organization for this series of congresses. Steps toward this were taken at the Second Pan-Pacific Science Congress, held in Sydney and Melbourne in 1923, by the adoption of the following resolutions:

(1) That this congress recommends the establishment of a permanent organization of the scientific institutions and individuals engaged in research on the scientific problems of the Pacific region;

(2) That the president of the Third Pan-Pacific Science Congress request the National Research Council or similar institution or agency of each of the following countries, *viz.*, Australia, Canada, Chili, France, Great Britain, Japan, Netherlands, New Zealand, the Philippine Islands and the United States of America, to appoint a member of an organization committee, the chairman of the committee to be a resident of the country in which the congress will be held, and that the committee be empowered to add to its membership representatives from other Pacific countries;

(3) That the organization committee be requested to prepare a preliminary draft of the constitution and methods of procedure of the organization and to report its recommendations to the next congress.

The international organization committee formed according to Resolution 2 is constituted as follows, and the draft constitution and by-laws prepared by this committee will be submitted at the general meeting of the Third Congress.

INTERNATIONAL ORGANIZATION COMMITTEE

United States of America	Dr. T. Wayland Vaughan
Australia	Sir David Orme Masson
Canada	Dr. R. W. Brock
France	Prof. A. Lacroix
Great Britain	Sir Gerald Lenox-Conyngham
Hawaii	Dr. H. E. Gregory
Japan	Dr. Joji Sakurai
The Netherlands	Dr. F. A. F. C. Went
The Netherlands E. Indies	Dr. W. M. Docters van Leeuwen
New Zealand	Dr. P. Marshall
Philippine Islands	Dr. W. H. Brown

Among those who are planning to attend this congress from the United States and the Hawaiian and Philippine Islands are the following:

From the continental area of the United States:

Wallace W. Atwood, president, Clark University, Worcester, Massachusetts; and Mrs. Atwood.

Louis W. Austin, director, Laboratory for Special Radio Transmission Research, United States Bureau of Standards, Washington, D. C.; and Mrs. Austin.

Harley H. Bartlett, professor of botany, University of Michigan, Ann Arbor, Michigan.

Arthur L. Day, director of the Geophysical Laboratory of the Carnegie Institution of Washington, Washington, D. C.

Nevin M. Fenneman, professor of geology, University of Cincinnati, Cincinnati, Ohio.

Caroline E. Furness, professor of astronomy, Vassar College, Poughkeepsie, New York.

Walter Granger, associate curator of fossil mammals, Department of Vertebrate Paleontology, American Museum of Natural History, New York City.

F. S. Harris, president, Brigham Young University, Provo, Utah; and Mr. M. H. Harris.

N. H. Heck, chief, Division of Terrestrial Magnetism and Seismology, United States Coast and Geodetic Survey, Washington, D. C.

Maurice Holland, director, Division of Engineering and Industrial Research, National Research Council, New York City.

Louise F. Jenkins, 383 Ellsworth Avenue, New Haven, Connecticut.

Andrew C. Lawson, professor of geology and mineralogy, University of California, Berkeley, California.

C. K. Leith, professor of geology, University of Wisconsin, Madison, Wisconsin; and Mrs. Leith.

G. W. Littlehales, hydrographic engineer, Navy Department; professor of nautical science, George Washington University, Washington, D. C.

George F. McEwen, associate professor, oceanographer and curator of the Oceanographic Museum, Scripps Institution of Oceanography, La Jolla, California.

R. R. Martel, associate professor of civil engineering, California Institute of Technology, Pasadena, California.

W. C. Mendenhall, chief geologist, United States Geological Survey, Washington, D. C.

C. H. Myers, professor of plant breeding, New York State College of Agriculture, Cornell University, Ithaca, New York.

Nels C. Nelson, associate curator of archeology, American Museum of Natural History, New York City.

Levi F. Noble, Valyermo, California; Mrs. Noble and Miss Marjorie Evans.

George H. Parker, professor of zoology, Harvard University, Cambridge, Massachusetts; and Mrs. Parker.

Harry Fielding Reid, professor of dynamic geology and geography, Johns Hopkins University, Baltimore, Maryland; and Mrs. Reid.

W. A. Setchell, professor of botany, University of California, Berkeley, California; and Mrs. Setchell.

Frederick Starr, 5727 Thirty-fifth Avenue, N. E., Seattle, Washington.

Walter T. Swingle, senior physiologist in charge of crop physiology and breeding investigations, Bureau of Plant Industry, United States Department of Agriculture, Washington, D. C.; and Mrs. Swingle.

Shira Tashiro, professor of biochemistry, University of Cincinnati, Cincinnati, Ohio.

Josephine E. Tilden, professor of botany, University of Minnesota, Minneapolis, Minnesota; and Miss Crosby.

Glenn T. Trewartha, assistant professor of geography and climatology, University of Wisconsin, Madison, Wisconsin.

T. Wayland Vaughan, director, Scripps Institution of Oceanography, La Jolla, California; Mrs. Vaughan and Miss Vaughan.

Victor C. Vaughan, chairman, Division of Medical Sciences, National Research Council, Washington, D. C.; and Mrs. Vaughan.

Bailey Willis, professor of geology, emeritus, Stanford University, Stanford University, California; Mrs. Willis and Miss Margaret Willis.

From the Hawaiian Islands:

C. Montague Cooke, malacologist, Honolulu, Hawaii.

Herbert E. Gregory, Silliman professor of geology, Yale University; director of the Bernice Pauahi Bishop Museum of Polynesian Ethnology and Natural History, Honolulu; and Mrs. Gregory.

E. S. Craighill Handy, ethnologist, Honolulu.

Willowdean Chatterson Handy, ethnologist, Honolulu.

T. A. Jaggar, director, Hawaiian Volcano Observatory, Honolulu; and Mrs. Jaggar.

From the Philippine Islands:

William H. Brown, director, Philippine Bureau of Science, Manila.

Victoriano Elicaño, assistant director, Philippine Bureau of Science, Manila.

Jose M. Feliciano, professor and head of the department of geology, University of the Philippines, Manila.

Bienvenido M. Gonzales, professor of animal industry, College of Agriculture, University of the Philippines, Los Baños.

Albert W. Herre, chief, Division of Fisheries, Philippine Bureau of Science, Manila; and Mrs. Herre.

Rev. Roque Ruaño, Faculty of Civil Engineering, University of Santo Tomas, Manila.

Rev. Miguel Selga, assistant director, Philippine Weather Bureau, Manila.

In addition to these representatives, American institutions and organizations will be further represented as follows:

George B. Cressey, professor of geology, Shanghai College, Shanghai, China.

N. Gist Gee, Peking Union Medical College, Peking, China; representing the China Medical Board of the Rockefeller Foundation.

Fusanobu Isobe, of the Suzuki Company, Kobe, Japan; representing Indiana University.

Kozo Kashima, Rikugun Kwagaku Kenkyujo, Ohkubo Hyakuninmachi, near Tokyo, Japan; representing the American Chemical Society.

S. Koku and M. Watanabe, of the Mineralogical and Petrographical Institute of Tohoku Imperial University, Sendai, Japan; representing the Mineralogical Society of America.

W. C. Lowdermilk, College of Agriculture and Forestry, University of Nanking, Nanking, China; representing the Society of American Foresters; and Mrs. Lowdermilk.

R. Howard Porter, Nanking University, Nanking, China; representing the American Phytopathological Society.

SCIENTIFIC EVENTS

RESEARCH IN COLLEGES

AFTER consultation with officers of the American Council on Education, the American Historical Association and the National Research Council, and with numerous college officers and teachers, a conference was called in Washington in March, 1925. Twenty-four colleges and educational organizations were represented. Endeavor to promote research in the colleges was unanimously approved and many suggestions were made as to methods. The conference voted unanimously to ask the Division of Educational Relations of the National Research Council "to proceed, in their discretion, to the organization of a committee or board to study the subject of promotion of productive scholarship among the teachers in American colleges and to move to its accomplishment." They also appointed a committee of five to bring this matter to the attention of said Division of Educational Relations and to act in forwarding this project in any further ways which seem to them advisable.

The committee brought the project to this division of the National Research Council, which unanimously approved the idea and reacted favorably to the general plan presented. The division, at a later meeting, voted in favor of a series of conferences between a representative of the division and "the colleges concerned."

In August of this year, at Woods Hole, teachers from twenty-two colleges and four universities, after discussion of the matter, unanimously approved of the general plan and of asking the National Research Council to take the initiative in approaching the colleges as to the project. They also approved unani-

mously the formation of research committees in the several colleges, with cooperation between these committees in promotion of research. They further voted to publish a brief history of the project and the steps already taken to forward it, with a list of the suggestions as to aims, plan and methods of promoting research by teachers in colleges. This report, with plan and suggestions as to ways of promoting research in colleges, will be published in *School and Society.*

Reprints may be had upon request to Maynard M. Metcalf, the Johns Hopkins University, Homewood, Baltimore, Md. Professor Metcalf is a member of the Washington conference committee of five on promotion of research in the colleges and is secretary of the sub-committee of the American Association for the Advancement of Science on research in educational institutions. He solicits criticism of the project, the plan and the proposed methods of promoting research. Suggestions will be very welcome.

COMMITTEES OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

At the first meeting of the board of directors of the American Institute of Electrical Engineers for the administrative year beginning on August 1, President Chesney announced his committee appointments. The chairmen are as follows:

General Committees

Board of Examiners.—Erich Hausmann, Brooklyn, N.Y.

Finance.—H. A. Kidder, New York.

Sections.—Harold B. Smith, Worcester, Mass.

Meetings and Papers.—E. B. Meyer, Newark, N. J.

Publication.—L. F. Morehouse, New York.

Coordination of Institute Activities—Farley Osgood, New York.

Student Branches.—C. E. Magnusson, Seattle.

Membership.—L. S. O'Roark, New York.

Headquarters.—G. L. Knight, Brooklyn, N. Y.

Law.—W. I. Slichter, New York.

Public Policy.—Gano Dunn, New York.

Code of Principles of Professional Conduct.—John W. Lieb, New York.

Safety Codes.—J. P. Jackson, New York.

Standards.—J. F. Meyer, Washington.

Edison Medal.—Gano Dunn, New York.

Award of Institute Prizes.—E. B. Meyer, Newark, N. J.

Columbia University Scholarships.—W. I. Slichter, New York.

Licensing of Engineers.—Francis Blossom, New York.

Technical Committees

Communication.—H. P. Charlesworth, New York.

Education.—Paul M. Lincoln, Ithaca, N. Y.

Electrical Machinery.—H. M. Hobart, Schenectady, N. Y.

Electrochemistry and Electrometallurgy.—G. W. Vinal, Washington, D. C.

Electrophysics.—V. Karapetoff, Ithaca, N. Y.

Instruments and Measurements.—A. E. Knowlton, New Haven, Conn.

Applications to Iron and Steel Products.—A. G. Pierce, Cleveland.

Production and Application of Light.—P. S. Millar, New York.

Applications to Marine Work.—G. A. Pierce, Philadelphia.

Applications to Mining Work.—W. H. Lesser, Frackville, Pa.

General Power Applications.—A. M. MacCutcheon, Cleveland.

Power Generation.—H. W. Eales, St. Louis.

Power Transmission and Distribution.—Philip Torchio, New York.

Protective Devices.—F. L. Hunt, Greenfield, Mass.

Research.—John B. Whitehead, Baltimore.

Transportation.—Cary T. Hutchinson, New York.

The board confirmed the appointment by President Chesney of new members of the Edison medal committee, for terms of five years each, as follows: John W. Howell, Harrison, N. J.; L. F. Morehouse, New York; David B. Rushmore, New York. The board also elected three of its membership as members of the Edison medal committee, for terms of two years each, namely, B. G. Jamieson, Chicago; H. A. Kidder, New York, and G. L. Knight, Brooklyn, N. Y.

THE AMERICAN ELECTROCHEMICAL SOCIETY

The autumn meeting of the American Electrochemical Society will be held at Washington, D. C., under the presidency of Dr. William Blum, of the Bureau of Standards, on October 7, 8 and 9, with headquarters at Hotel Washington.

Dr. H. W. Gillett, of the Bureau of Standards, will be responsible for a symposium on "Materials for Extreme Conditions in the Electrochemical Industries," scheduled for Thursday morning. Thursday afternoon will be devoted to a trip to Mt. Vernon, and on Thursday evening there will be a dinner followed by a dance at Hotel Washington. The dinner will be a joint one with the local members of the American Chemical Society.

Friday morning will be devoted to papers on electrodeposition and on Friday noon a round table discussion will be held under the chairmanship of Professor E. M. Baker. The subject will be "Preparation for Electrodeposition." The afternoon will be devoted to trips to laboratories and industrial plants. In the evening, Dr. Charles Greeley Abbot, of the Smithsonian Institution, will address the members at a reception at the National Academy of Sciences Building. Saturday morning will be devoted to papers on organic electrochemistry.

THE INTERNATIONAL CONGRESS OF PHILOSOPHY

THE sixth International Congress of Philosophy was held from September 13 to 16, at Harvard University, with approximately three hundred active members in attendance, including sixty-nine from eighteen countries outside the United States, opening on Monday evening in Gore Hall dining room. According to the program President Nicholas Murray Butler, of Columbia University, chairman on behalf of the organizing committee of the congress, made the first address of welcome. He was followed by President A. Lawrence Lowell, on behalf of Harvard University; President W. E. Hocking, on behalf of the American Philosophical Association, eastern division; President R. C. Lodge, for the western division of the association, and President H. W. Stuart, for the Pacific division of the association. There followed the presentation of the foreign delegates, who by advance registration were distributed as follows: Belgium, 1; Canada, 10; Czechoslovakia, 3; France, 6; Germany, 12; Great Britain, 14; Holland, 1; India, 2; Italy, 4; Japan, 3; Poland, 5; Portugal, 1; Russia, 1; South Africa, 1; South America, 1; Spain, 1; Switzerland, 1, and Turkey, 1. Dr. Paul Lapie, rector of the University of Paris, responded on behalf of the foreign delegates. At the conclusion of the formal exercises a smoker was held in Gore Hall common room.

The program of the congress has been grouped as follows: Division A—metaphysics, philosophy of nature, philosophy of mind, philosophy of religion. Division B—logic, epistemology, philosophy of science. Division C—ethics, theory of value, social philosophy, esthetics. Division D—the history of philosophy.

Apart from numerous sectional meetings each division arranged a general program as follows:

DIVISION A

The hypothesis of emergent evolution, its meaning and the present state of the argument concerning it.

Chairmen—James R. Angell, Yale; H. S. Jennings, Johns Hopkins.

Speakers—Hans Driesch, Leipzig; H. Wildon Carr, London; Arthur O. Lovejoy, Johns Hopkins; W. M. Wheeler, Harvard.

DIVISION B

Continuity and discontinuity among the sciences.

Chairmen—Frank Thilly, Cornell; F. J. E. Woodbridge, Columbia.

Speakers—Federigo Enriques, Rome; Erich Becher, Munich; W. E. Hocking, Harvard.

DIVISION C

Philosophy and international relations.

Chairmen—James H. Tufts, Chicago; Wilbur M. Urban, Dartmouth.

Speakers—Charles Bouglé, Sorbonne (La philosophie, la democratie, et la paix); Erich Becher, Munich (Darwinism and international relations); Coriolano Alberini, Buenos Aires; Roscoe Pound, Harvard (The part of philosophy in international law).

DIVISION D

The rôle of philosophy in the history of civilization.

Chairmen—A. C. Armstrong, Wesleyan; Alexander Meiklejohn, Wisconsin.

Speakers—Henry Osborn Taylor, New York; Etienne Gilson, Sorbonne; John Dewey, Columbia; S. Radhakrishnan, Calcutta; Benedetto Croce, Naples (The modern conception of philosophy, read by Raffaelo Piccoli, Naples).

SCIENTIFIC NOTES AND NEWS

ON the occasion of the anniversary meeting of the American Chemical Society, the University of Pennsylvania conferred honorary degrees on Sir James Colquhoun Irvine, principal of St. Andrews University; Gionori Conti, senator of Italy; Professor Paul Sabatier, University of Toulouse, and Professor Ernest Cohen, University of Utrecht.

AFTER the Priestley Medal had been conferred by the American Chemical Society on Dr. Edgar Fahs Smith, professor of chemistry and former provost of the University of Pennsylvania, in accordance with the award already announced, Professor Walter Taggart, of the university, presented to Dr. Smith a diploma from the University of Göttingen renewing after fifty years the doctorate of philosophy that had been awarded in 1876.

DR. WILFRED WATKINS-PITCHFORD has resigned as director of the South African Institute for Medical Research, Johannesburg, and as chairman of the miners' phthisis medical bureau on account of ill health.

DR. OTTO FISCHER, director of the State Art Gallery at Stuttgart, has been made honorary adviser of the Chinese federal museums and art galleries, with headquarters at Peking.

THE following have been elected officers of the Röntgen Society, London, for the session 1926–1927: *President*, Mr. N. S. Finzi; *Vice-presidents*, Dr. Robert Knox, Professor A. W. Porter, Professor S. Russ; *Honorary Treasurer*, Mr. Geoffrey Pearce; *Honorary Editor*, Dr. G. W. C. Kaye; *Honorary Secretaries*, Mr. Russell J. Reynolds, Professor F. L. Hopwood.

PROFESSOR E. A. SEAGAR, of the Imperial College of Tropical Agriculture at St. Augustine, Trinidad, at the invitation of the International Health Board, sailed for New York in August to attend a series of health conferences.

DR. WILFRED H. OSGOOD, of the Field Museum of Natural History, sailed on September 8 for Abyssinia, where he expects to collect fossils of mammals. He will be accompanied by Louis A. Fuertes, naturalist and artist; Suydam Cutting, volunteer motion picture operator, of New York, who accompanied the Roosevelt expedition to "the top of the world"; James E. Baum, Jr., sportsman, who will act as the news writer of the expedition, and Alfred M. Bailey, naturalist and taxidermist, of New York.

PROFESSOR IRVING W. BAILEY, of the Bussey Institution of Harvard University, sailed for Europe on September 4 to continue an investigation on forestry.

DR. EUGENE A. SCHWARZ, specialist in Coleoptera at the Bureau of Entomology, retired from active service, on account of age, on August 20. Dr. Schwarz is now eighty-two years old. Some years ago he was made honorary president for life of the Entomological Society of Washington.

DR. KARL RUNGE, professor of mathematics and physics at the University of Göttingen, celebrated his seventieth birthday on August 30.

AN honorary degree has been conferred by the University of Mexico on Professor H. Obermaier, of the University of Madrid, in tribute to his research on prehistoric anthropology.

RAMSEY INSTITUTE OF TECHNOLOGY, Saint Paul, Minn., has conferred upon Frederick E. Brasch, treasurer and assistant secretary of the History of Science Society, the degree of master of science, in recognition of his work in astronomy and the history of science.

DR. HERBERT GROVE DORSEY, of Gloucester, Mass., formerly research engineer at the Submarine Signal Corporation of Boston and inventor of the submarine fathometer for visually measuring ocean depths by sound waves, has been appointed electrical engineer in the division of hydrography and topography of the United States Coast and Geodetic Survey. While Washington will be his headquarters, work will begin first at Wilmington, N. C., in coordinating sonic methods of depth measurements with radio-sonic methods of position location for ocean chart making.

DR. LUCIEN HOWE, who recently gave an endowment of $250,000 to Harvard University for the founding of a laboratory for the study of the human eye, has given up his practice in Buffalo preparatory to his departure for Boston, where he is to take up his residence for the supervision of the work which he has started.

SIR FREDERICK KEEBLE, Sherardian professor of botany in the University of Oxford, has accepted an appointment with the Synthetic Ammonia and Nitrate Company, which is associated with Messrs. Brunner, Mond and Company, for the promotion of research in the application of synthetic nitrogen compounds to agricultural purposes.

DURING the past summer Dr. G. F. Sleggs, recently of the Scripps Institution of Oceanography of the University of California, and now professor of biology at the newly established Memorial University College of Newfoundland and oceanographer to the Newfoundland Government, has carried out biological and hydrographical research in Bonavista Bay, Trinity Bay, Conception Bay and other important Newfoundland fishery grounds. Samples of water have been obtained from a wide area and from accurately known depths for a study of plankton and temperature variations. A drift-bottle experiment has also been carried out, a satisfactory proportion of the bottles having already been recovered. The standard methods of the Scripps Institution have been largely adopted in this work, which is in cooperation with the North American Committee on Fishery Investigations and is the first of its kind to be officially supported by the Newfoundland government.

FIFTEEN foreign botanists taking part in the western field trip of the International Congress of Plant Sciences spent September 2 at Fort Collins, Colorado, as guests of the Colorado Agricultural College. Under the leadership of Dr. Herbert C. Hanson, in charge of ecological work at the college, a brief field survey was made of the vegetation of the region. Among those participating in the discussions were Drs. E. Rübel and John Briquet, of Switzerland; A. B. Rendle and T. W. Woodhead, of England, and F. E. Clements and Geo. D. Fuller, of the United States.

DONALD B. MACMILLAN, with the twenty-six members of the expedition to the Arctic Circle sent out by the Field-Columbian Museum, arrived at Tenant's Cove, Me., on September 10. The expedition is reported to have been completely successful.

A RADIOGRAM from the schooner *Morrissey,* on which Captain Robert Bartlett and a party have been conducting research work in the Arctic regions, has been received, reporting that the expedition is on the way home.

H. H. BENNETT, of the bureau of soils of the U. S. Department of Agriculture, has recently returned to Washington from southern Cuba after making a

reconnaissance soil survey of it for the department in cooperation with the Cuban Sugar Club.

DR. G. J. HUCKER, associate bacteriologist of the New York Agricultural Experiment Station, has recently sailed for Scotland and England, *en route* to Copenhagen and Stockholm. During the coming year he will continue his studies of the streptococci, working with Dr. S. Orla Jensen and Dr. Chr. Barthel. He has an appointment as fellow under the International Education Board.

DR. GEORGE FRANKLIN BABBITT, for twenty years health commissioner of Boston and a member of the staff of *The Boston Herald*, died on September 5, aged seventy-eight years.

AN Associated Press dispatch, dated September 8, reports that Dr. Aldo C. Massaglai, professor of bacteriology and pathology at the University of Mississippi, died *en route* to America from Italy, where he had been visiting his father.

DR. H. B. GUPPY, known for his extensive study of coral reefs in the Solomon and Fiji Islands and for his studies of plant distribution, died last April at Fort de France, Martinique, on his return voyage from a visit to Tahiti.

DR. HERBERT WILLIAM PAGE, the well-known British surgeon, has died in London at the age of eighty-one years.

THE death is announced of Dr. Richard Pohle, professor of geography in the Technical Institute at Braunschweig.

THE annual conference of the directors of sixteen European zoological gardens met at Vienna from August 30 to September 2. The object of the gatherings is the exchange of experiences since the last congress in various realms, such as the better housing of animals in the various seasons, the fight against rats and other plagues of zoological gardens, the exchange of animals and the like.

SIR FREDERICK WALKER MOTT, honorary director of the Research Board on Mental Diseases for the City and University of Birmingham, has left the residue of his estate, subject to certain trusts, failing which, with remainder to the University of London for the endowment or partial endowment of a professorship of psychological medicine "at my Alma Mater," the Medical School of University College Hospital, stating that he did not wish the professorship to be founded until there should be sufficient accommodation for the study and treatment of early cases of mental disorder either by wards in University College Hospital or in an affiliated mental hospital.

LECTURES to be given during October in the lecture hall of the museum building of the New York Botanical Gardens are as follows:

October 2.—"The Royal Botanic Gardens at Kew, England," Dr. Arthur W. Hill.
" 9.—"Autumn Colors," Dr. A. B. Stout.
" 16.—"Autumn Flowers," Dr. G. Clyde Fisher.
" 23.—"Difficulties in Propagation," Dr. William Crocker.
" 30.—"Botanizing in Trinidad," Dr. Fred J. Seaver.

Eugenical News states that Dr. Jon Alfred Mjøen, of Winderen, Oslo, Norway, has submitted a bill to the Norwegian government and the Storthing, at the request of the minister of social affairs, relating to the biological control of immigration. It appears that despite the fact that Norway is not capable of supporting a large population and is pronouncedly an emigration land, still, with the increasing of the difficulties of migrating to North America, many immigrants from Southeastern Europe are coming to Norway. Certain provisions of the bill include the notification of aliens to the police; the giving of permits to aliens for a definite period, not to exceed one year; provision for renewal of permit for an additional period; the elimination of the mentally, emotionally or physically inept; provision for a minimum number of aliens who are given permission to reside in the country for an indefinite period.

To give a better presentation of the topography of the 40,000-acre Harriman State Park, the United States Geological Survey has undertaken the complete revision of its maps covering the Highlands of the Hudson and part of the Ramapo Mountains. The new maps, which will be of great value to the thousands of campers and hikers who use this region and are at present handicapped by the inaccurate and antiquated maps now in use, will be drawn on a scale of 1,000 feet to the inch, five times larger than the old ones. The contour lines, or circles indicating altitude, will be inserted at each ten-foot rise instead of at twenty feet, as formerly. The work, which also includes the mapping of new trails, artificial lakes, camps, etc., is under the general direction of Dr. George Otis Smith, director of the survey. He is being assisted by Colonel Glenn S. Smith, acting chief topographic engineer, and Major W. A. Welch, general manager and chief engineer of the Harriman Park. The field work, under the direction of Albert Pike, topographical engineer of the middle Atlantic section, is being carried on by fourteen men in seven field parties, who will be engaged up to winter.

To stop the loose sand around the totem poles at Kitwanga, British Columbia, from blowing in the mouths and eyes of tourists and from getting in their

shoes, Mr. Harlan I. Smith is having desert shrubs set out and is selecting other shrubs to be set in between these. Then clover and grass will be planted, which being sheltered can grow where the tourists pass. This clover and grass will be feed for the Indians' cattle and they will crop it close, thus saving the expense of a lawn-mower. The trees along the path, the shrubs and wild flowers to be scattered among them will make the Kitwanga Garden of Native Plants of great interest to tourists. There are now many individual specimens of over twenty-four species on the tourists path and part of these are already labeled. Mr. Smith would be glad to receive labels or books from which labels may be cut to weatherproof, mount and frame for use until labels embodying the native Indian uses may be printed. Such names with description as are found in Reed's Wild Flowers serve fairly well, and as weatherproofed by Mr. Smith will last through rain and snow for from two to five years.

A dam costing $100,000 is being constructed by the Engineering Foundation Committee on Arch Dams. The dam is later to be destroyed in studying various questions of dam construction. Dr. Charles David Marx, professor emeritus of civil engineering at Leland Stanford Junior University, has been elected chairman of the committee to carry on the work. The dam is being built on Stevenson Creek, a tributary of the San Joaquin River, about sixty miles east of Fresno, Cal. Engineers in many countries are cooperating, W. A. Slater, of the U. S. Bureau of Standards, has taken charge of tests at the dam. Many small models will be built and tested as the work on the large dam proceeds.

UNIVERSITY AND EDUCATIONAL NOTES

Columbia University is the beneficiary in the will of Mrs. Annie C. Kane of two gifts of $500,000, one to be devoted to religious instruction, the other unconditional, to be used for whatever purpose the trustees may see fit. Mrs. Kane also left $1,000,000 to the New York City Home for Incurables on condition that part be used for a building where incurable cases of cancer shall be treated.

A bequest amounting to nearly £100,000, which is to be divided between the University College of Wales, Aberystwyth and the National Library of Wales, is made in the will of the late Sir John Williams, of Blaenllynant, Aberystwyth. In addition, gifts of £1,550 and of pictures, books and MSS. are made to the latter of these institutions.

Dr. F. W. Owens, for nineteen years a member of the faculty of Cornell University, has accepted an invitation to become head of the department of mathematics in the School of Liberal Arts at the Pennsylvania State College. He will begin his work with the opening of college this month, succeeding the late Professor Joseph Moody Willard, who died in 1923.

Alfred W. Gauger, Ph.D. (Princeton), has been appointed to take charge of the work of the Engineering and Mining Experiment Station of the University of North Dakota.

Dr. E. L. Reed has resigned his position as professor of biology at John Tarleton Agricultural College at Stephenville, Texas, to accept a professorship of botany at the Texas Technological College at Lubbock.

Fellows in medicine of the National Research Council have accepted positions as follows: David L. Drabkin, M.D., for two years fellow in biochemistry at Yale University, has been appointed to an instructorship in the department of biochemistry in the University of Pennsylvania, and C. H. Thienes, M.D., for one year a fellow at Stanford University Medical School, is now assistant professor of pharmacology in the University of Oregon Medical School.

Dr. W. Robinson, senior lecturer in the department of cryptogamic botany in the University of Manchester, has been appointed to the chair in botany in University College, Aberystwyth, in succession to Professor Lloyd Williams, who retires under the age limit in September.

DISCUSSION

RADIATING POTENTIALS OF THE BAND SYSTEMS OF CARBON MONOXIDE

Whereas an atom can absorb energy only by a change in the configuration of its electrons, a molecule can absorb energy by changes in the configuration of the nuclei of its constituent atoms and by changes in its speed of rotation as well as by changes in the arrangement of its electrons. When a molecule absorbs energy by one or more of these processes, it is said to be in an excited state. Transitions between its possible states give rise to the absorption or emission of its spectrum. Coupled with each electronic transition there may be several vibrational (nuclear) transitions, and coupled with each vibrational transition there may be a number of rotational transitions. On account of these coupled transitions molecular spectra are characterized by associated band groups constituting band systems.

The bands of a system are all due to the same electronic transition, and so an entire system in molecular spectra replaces a single line in atomic spectra. The energy, in equivalent volts, necessary to change a molecule from its normal state to one of its excited

states is the excitation potential of that state and the radiating potential of all spectral lines which require this as the initial state of the molecule. We shall define the radiating potential of a band system as the excitation potential of the zero vibrational and zero rotational level of the initial state.

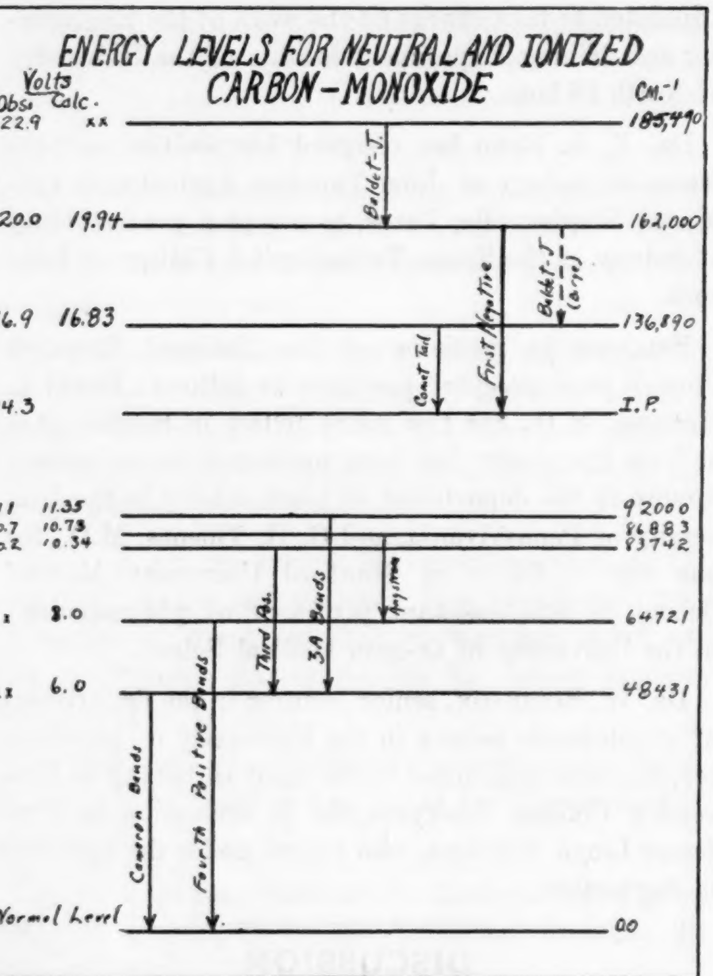


FIG. 1

The radiating potentials of the band systems of the neutral and ionized carbon monoxide molecule, except the Fourth Positive and Cameron bands, were determined by a photographic method, the spectra being excited by electron impacts. The spectra were analyzed on the basis of the quantum theory of band spectra and the relationships between the several systems were determined from these analyses. These relationships have been determined in a similar manner for a part of the bands by Birge[1] and for another part by Johnson.[2] After these relationships have been determined, it is possible to calculate the radiating potentials of the systems. The accompanying diagram indicates these relationships and gives the observed and the computed values of the radiating potentials of the several systems. It will be noticed that the observed radiating potentials confirm the system relationships deduced from the analyses in all cases except that of the Baldet-Johnson system. This system contains so few bands that its relation to others can not be determined with certainty by analysis.

[1] *Nature*, 117, 230, 1926.

[2] *Nature*, 117, 376, 1926.

From the results of our investigation it seems that several bands usually included in the Ångstrom system were due to impurities in the gas employed by the original investigators. They fail to appear on any of our spectrograms and, furthermore, do not fit into the term scheme of this system. On the other hand, two bands not previously reported with edges at λ3680.5 and 3894.3 seem to belong to this system. Further work is in progress on the measurement and analysis of the Ångstrom bands.

In a letter to *Nature* (Vol. 118, 12, 1926), the writers described an experiment which demonstrated that the Third Positive carbon bands belong to CO and really comprise two systems which we called the Third Positive and 3A systems. During the course of that experiment new bands were discovered in the spectrum of the flowing gas. They extend from about λ3000 to 5000A. It was concluded from their manner of excitation that they belong to CO_2. An investigation of these bands is now in progress in this laboratory. It was found that some of the strongest of these bands appear in the spectrum of the low voltage arc in CO in the region of the Ångstrom system. It requires strong excitation at pressures of the order of 2 mm to bring them out. Their presence in the arc in CO is accounted for by the dissociation of CO and the subsequent formation of CO_2 during the passage of the discharge.

O. S. DUFFENDACK,
GERALD W. FOX

UNIVERSITY OF MICHIGAN

THE RELATION OF NITRATES TO TOBACCO FRENCHING[1]

TOBACCO frenching is a disease in which the new leaves are chlorotic, especially between the veins. The leaves may be normal in shape but in severe cases are narrow and ribbonlike. They finally develop normal color. Although little is known in regard to the disease, it is generally believed to result from adverse soil conditions, especially poor drainage.

The past winter Turkish tobacco plants, growing in highly organic soil from a forest on the Kentucky Experiment Station farm, frenched, thus giving an opportunity for a study of the disease in pots in the greenhouse. A total of over two hundred frenched plants have been produced in soil and sand cultures. As quite definite results have been obtained both in producing the disease and in controlling it under greenhouse conditions, a short statement of the results obtained will be given.

[1] Published by permission of the Director of the Kentucky Agricultural Experiment Station.

In half-gallon jars of soil the disease usually appears in Turkish tobacco plants soon after the first evidence of nitrogen deficiency in the lower leaves. Frenched plants may be brought back to normal growth by the addition of a complete nutrient solution or by the addition of nitrogen in the form of calcium, sodium or potassium nitrate, ammonium sulfate, urine and other common sources of nitrogen. Recovery will also result when an excised top of a frenched plant is grafted on a healthy plant or when placed in tap water (containing a trace of nitrate) or in a complete nutrient solution or in a weak solution of nitric acid with an excess of calcium carbonate.

Soil which has produced frenched plants rapidly recovers its ability to produce a normal plant if allowed to stand a short time. The removal of one plant from a jar in which two frenched plants are growing will often result in recovery of the other.

These results and others of a similar nature suggest that frenching is brought about when the rate of carbohydrate metabolism proceeds relatively more rapidly than nitrogen absorption. This results in the production of leaf tissue which, in the absence of sufficient available nitrogen, can not develop chlorophyl and other necessary cell constituents as fast as they are required for the production of a normal green leaf.

The marked similarity between the symptoms of apple[2] and pecan rosette[3] and tobacco frenching suggests that the three diseases have a common cause; namely, a deficiency of available nitrogen. This is further strengthened by the fact that nitrates added to the soil bring about rapid recovery of frenched tobacco plants, while organic matter, especially legumes, plowed under has been found to bring about recovery of affected pecan and apple trees in the course of two or three years.

W. D. VALLEAU
E. M. JOHNSON
KENTUCKY AGRICULTURAL
EXPERIMENT STATION

A WIDESPREAD ERROR RELATING TO LOGARITHMS

THE integral part of a logarithm is commonly called characteristic, while the decimal fraction part thereof is known as its mantissa and is the only part of a common logarithm which is found in the usual modern table of logarithms. In view of the fact that students of mathematics frequently meet the word mantissa for the first time when they begin the study of logarithms it may be assumed that some of them are inclined to consult a large dictionary for the purpose of learning something about the origin of this word. If they should happen to look up this term in a recent edition of "Webster's New International Dictionary," or of "The Century Dictionary and Cyclopedia" they would find the statement that the noted British mathematician, H. Briggs, used the term mantissa with its modern mathematical meaning. They would find the same misinformation on consulting the most recent American text-book on the general history of mathematics, for the purpose of obtaining more light as regards the origin of this term.

In view of the fact that this error is so widespread in works which are naturally consulted by many readers with unusual confidence as regards their reliability it may be desirable to note here that as far as is now known the word mantissa was first used as a mathematical term by J. Wallis in the Latin edition of his algebra, 1693. This was more than sixty years after the death of H. Briggs. The word mantissa does not appear in the English edition of this algebra, which was published eight years earlier than the Latin edition and has been said to contain the word in question. J. Wallis used this word with a more general meaning than that noted above, and some very good recent writers, including H. Weber, have followed his example in this respect. Since I have previously directed attention to various errors appearing in F. Cajori's "History of Mathematics," 1919, it gives me pleasure to be able to say here that as regards the term in question his statement on page 152 is essentially correct.

G. A. MILLER
UNIVERSITY OF ILLINOIS

LITERATURE CITATIONS

MAY I add my bit to the discussion of literature citations from the standpoint of a user. The method of indication of references recommended by *Chemical Abstracts* has a logical sequence of arrangement.

In the case of a typical reference, J. Amer. Chem. Soc. **48**, 34 (1926), the first subject of interest is the journal, which thus refers to certain shelves in the library. This leaves a block containing the volume in heavy type or underlined in typewritten or handwritten notes, the page and the year. The volume, and series if more than one, are outstanding because of their location as the first item or items of the block, and because the volume is in heavy face type.

In general the reference is located by the volume number, in only isolated cases by the year. Only when the volume is located is the page reference of

[2] Morris, O. M., "Apple Rosette," Wash. Agr. Exp. Sta. Bul., 177, 1923.

[3] Skinner, J. J., and J. B. Demaree, "Relation of Soil Conditions and Orchard Management to the Rosette of Pecan Trees," U. S. Dept. of Agr. Dept. Bul., 1378, 1926.

importance. Its relative importance is greater if the volume is bound in two or more books.

Thus this form of reference forms a logical sequence; journal, series, volume number, page reference, lastly year as a check in case of error in the preceding references. Too many references which follow this system in other respects omit the year of publication.

This method of indication places the parts of the reference in their order of importance and use.

FOSTER DEE SNELL

BROOKLYN, N. Y.

SCIENTIFIC BOOKS

An Introduction to Economic Geography. Volume I. *Natural Environment as Related to Economic Life.* By WELLINGTON JONES and DERWENT S. WHITTLESEY. 375 pp., 366 figures. The University of Chicago Press, Chicago, 1925. $5.00.

"W. D. JONES and D. S. Whittlesey have just produced the best American work on economic geography." Thus has Jean Brunhes, the French geographer, characterized this recent addition to geographic literature. He might have added that it is almost the first presentation in text-book form that is strictly geographic in its contents and method. Most of the other works on economic geography that have appeared have been either physiographies with some emphasis on the influences of physiographic features upon man or descriptions of resources and industries with an attempt to show the relation of those resources and industries to environmental conditions. "An Introduction to Economic Geography" is a presentation of the newer tendencies in the teaching of geography in this country, especially as those tendencies are finding expression in the school of geography of the University of Chicago.

The present work is the first volume of a two-volume treatise. It deals with the natural environment and with some of the more significant relationships to economic life. The second volume, promised for the near future, will deal with the major economic activities and with their relationship to the natural environment. The two volumes are intended for use in introductory geography courses in colleges and in senior high schools.

"An Introduction to Economic Geography" follows none of the orthodox rules of text-book arrangement. There is no systematic treatment either by commodities or by countries. The first volume is divided into three major parts. The first part consists of a series of exercises and question groups covering the outstanding features of the environment. There are exercises on climate, land forms and soil, rocks and minerals, ground and surface waters, the ocean and coasts, and the shape, size and location of land masses. It is the intention of the authors that the student should secure his understanding of the principles of geography through working out the exercises inductively from materials supplied in the remaining two parts of the book.

Part II is text material covering the same range of subjects as the exercises. It includes factual material and explanations of the elements of the physical environment, together with brief descriptions of some vital activities of man as influenced by that element. Accompanying the explanation of the arid and semi-arid climates, there is a description of dry-farming as practiced in the western great plains region and of the life of the nomadic Khirghiz. With the section on land forms, there is an excerpt descriptive of the isolated and backward life of the southern Appalachians. Most of the text material has been prepared by the authors, but a part of it has been adapted for the present use from other sources.

Part III consists of illustrations, 366 in all. They include many maps and graphs, but the great majority are photographs, most of them taken by the senior author. There is an exceptionally good collection of geographic illustrations for the Orient, a result of Professor Jones's two trips to Asia. The folder of world maps is worthy of special notice. It contains excellent maps of world climatic regions, world temperature for January and July, semi-annual rainfall and land forms. The temperature maps show surface temperatures rather than the usually mapped sea level temperatures of so little significance to the geographer.

There are few adverse criticisms to be made of "An Introduction to Economic Geography." The treatment of a subject in each of the three parts of the book tends to weaken the continuity. It would seem preferable, at least, to combine Parts II and III and insert the illustrations throughout the book immediately with the pertinent text material.

The principal criticism is that the explanations of the elements of the environment are not always adequate. Geography, it is true, is not the study of the environment, but it is the study of the relationships that exist between that environment and living organisms. Without an understanding of both the organisms and the environment any understanding of their relationships is impossible. The absence of such necessary background may easily lead to an over-emphasis of superficial relationships or to an insistence on relationships that do not exist.

JOHN E. ORCHARD

SCHOOL OF BUSINESS,
COLUMBIA UNIVERSITY

SPECIAL ARTICLES

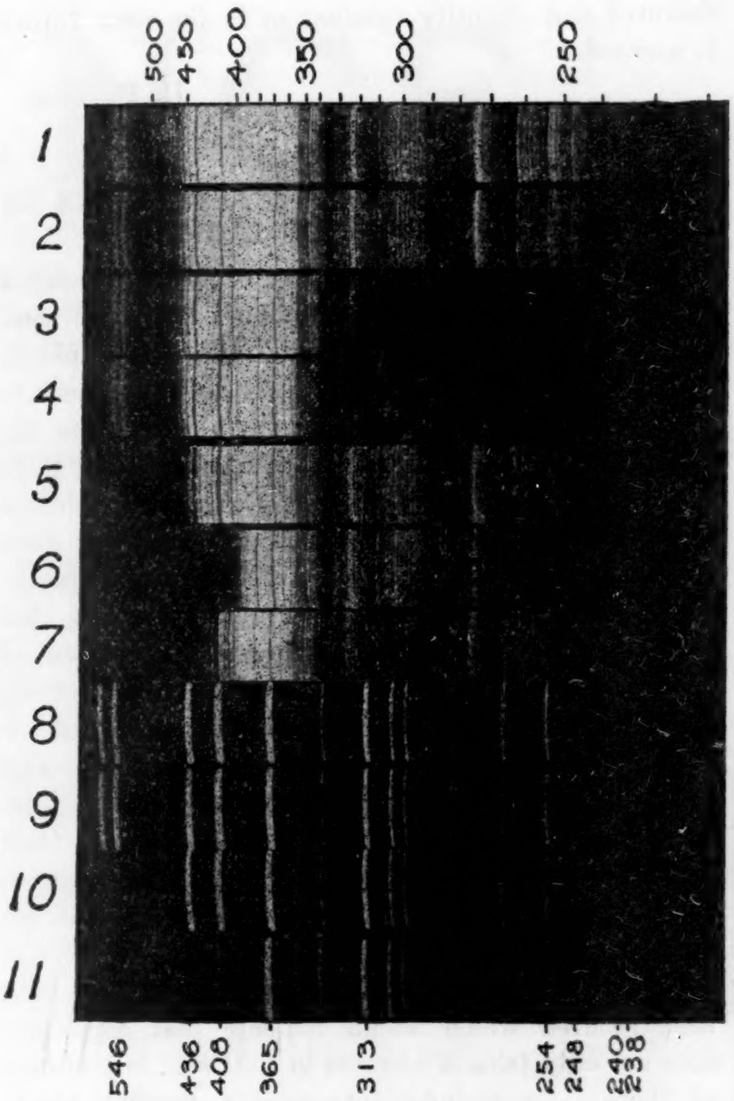
A NEW ULTRA-VIOLET TRANSMITTING GLASS

NUMEROUS attempts have been made toward the development of glasses, or suitable substitutes, capable of transmitting ultra-violet radiations shorter than the region neighboring 300 μμ. The number of possible applications for the use of ultra-violet light, especially full sunlight, has increased markedly during recent years and it has been the absence of materials of a required transparency within a reasonable price which has been largely responsible for their retarded development. Fused quartz glass possesses high transparency, but even with the great improvement in manufacturing methods the cost of covering a limited area is high. C. Fritsch has described a glass of boric oxide and fluospar which is claimed to transmit the 185 aluminum line. F. A. and C. L. Lindermann prepared a lithium borate glass showing no appreciable absorption above 200 μμ. In publishing the results of experiments leading to the development of Uviol, E. Zschimmer gives glasses transmitting to 186 μμ. In general, however, the glasses showing a marked increase in ultra-violet transparency over ordinary glasses sacrificed a great deal in resistance to weathering, or were melted under conditions which were impractical in general production. Hence no glasses other than quartz showing a high transmission in the region of 290 μμ were commercially available.

At Corning Glass Works there has been developed a new glass, 980A, transmitting to 200 μμ in three mm. thicknesses. Its transmission for wave lengths of 290 μμ, the extreme limit of the sun's rays through the atmosphere, is 86 per cent. through a two mm. thickness (uncorrected for surface reflections) as measured by the Bureau of Standards. For purposes requiring a full transmission of ultra-violet light from the sun, therefore, this glass is practically the equal of clear fused quartz. The accompanying spectrograms obtained by a quartz prism spectograph illustrate its transparency as compared with other glasses.

The glass may be prepared in various colors to produce unusual spectral filters. G985B is a blue transmitting the ultra-violet, but completely eliminating the green mercury line. G984B is green, giving a distinct absorption band in the ultra-violet. G986A is nearly opaque to visible rays, yet quite transparent in ultra-violet.

The drop in the transmission curve in the ultra-violet for glasses and other transparent bodies is not a sharp one, but covers a region of some 80 μμ in sweeping from nearly full transmission down to the extreme limit of transparency. For this reason the limit of transmission may be a misleading measure



The transmission of 980A and other glasses for ultra-violet radiation from an iron arc, and of a few unusual spectral filters for radiation from a quartz mercury lamp.

(1) Open iron arc
(2) 980A 3 mm.
(3) PYREX glassware 2.8 mm.
(4) Window glass 2.7 mm.
(5) 985B 4 mm.
(6) 986A 4.9 mm.
(7) 984B 5.3 mm.
(8) Open mercury arc
(9) 980A 3 mm.
(10) 985B 4 mm.
(11) 986A 4.9 mm.

of the value of a material for purposes requiring transparency. A glass transmitting to only 270 μμ is very apt to absorb a large portion of valuable energy in the neighborhood of 300 μμ.

The new glass has a density of 2.64, a refractive index for the D line of 1.539, a dispersion of .009 for $N_f - N_c$, a linear expansion coefficient at nearly $.0_41$, and possesses a stability within the range of ordinary glasses. The cost of producing the glass is somewhat above that of window glass, but is far below that of quartz.

Several hundred plates of the glass have been manu-

factured and quantity production in the near future is assured.

H. P. Hood

Corning Glass Works

NITRATE UTILIZATION BY ASPARAGUS IN THE ABSENCE OF LIGHT[1]

During the winter and spring of 1926 asparagus plants were grown in the greenhouse in quartz sand culture and in solution culture. Part of the plants were subjected to continuous darkness and others to the seasonal light conditions as they occurred in the greenhouse. The plants in the light and some of them in the dark were given a complete nutrient solution containing nitrates, while others grown in the dark were given a nutrient solution containing no nitrogen.

It has been found by several careful trials that an aliquot portion of an asparagus root crown of about 10 per cent. may be removed for analysis, while the remaining 90 per cent. may be used for experimental purposes. Quantitative analyses have also shown that the 90 per cent. and the 10 per cent. fractions are practically identical with respect to their percentage composition. Accordingly, the composition of asparagus crowns at the beginning of an experiment may be computed.

On an absolute amount basis, quantitative data have been secured which would indicate that asparagus may not only take in nitrates in the dark, but so long as there is a carbohydrate supply present plants seem able to build up nitrates to higher forms of nitrogen. This assimilation of nitrates seemed to occur as rapidly in the dark as in the light. Microchemical tests of plus nitrate series have consistently shown an abundance of nitrates in the fibrous absorbing roots, with none at all, or extremely small amounts of nitrates, in the storage roots. The rapidly growing spears in the dark contained no nitrates, except occasional traces in the lower parts of the spears. There were no nitrates in the spears which were grown in the light, except when the rate of vegetative extension was decreased by approaching maturity or as in the field by cold weather, at which times there was a large accumulation of nitrates in the tips and butts. At no time were nitrates found in any part of the minus nitrogen series.

As would be expected, the growth of the minus nitrogen series was associated with a decrease of protein and an increase of the nitrate free soluble nitrogen fraction, while in the plus nitrate series the growth was associated not only with a decrease of protein but as well with synthesis of nitrates to higher forms of nitrogen.

In the dissection of the nitrate free soluble nitrogen fraction there was determined proteose, polypeptide, amide, amino and humin nitrogen fractions. The carbohydrate fractions determined include total sugars, reducing sugars, sucrose, polysaccharides,[2] hemicellulose and fat. These data and further details concerning them will be given at another time.

Analysis of the roots of the several series show, as would be expected, that there was a considerable loss of carbohydrates associated with growth of spears. It would seem particularly significant that there was a much larger loss of carbohydrates in the plus nitrogen dark series than in the minus nitrogen dark series. Presumably, the larger loss of carbohydrates in the plus nitrogen dark series was due to the fact that the carbohydrates were used in assimilation of nitrates.

The experimental conditions obtaining would seem to minimize the possibility of bacterial action affecting the results secured and the work of Liman[3] and others would also tend to make such seem unlikely. In addition, the following observations would seem significant. Root crowns in plus nitrate solution culture grown in the dark and with tops removed daily had an abundance of nitrates in the fibrous absorbing roots and none in the storage roots. These crowns, after thorough washing, were placed in distilled water, and frequent observations of all parts of many crowns showed that nitrates disappeared in about two hours at 20° C. Like roots at a temperature of 10° C. still contained traces of nitrates in the fibrous roots after a period of about twelve hours. That there was no loss of nitrogen from the roots was indicated by macrochemical analysis of the residual distilled water for total nitrogen, ammonia and nitrate nitrogen.

Further data are being secured from field and controlled experiments. A study is also to be made of extracts of plant tissue and their effect upon nitrate solutions under varying conditions, in order to determine if the apparent utilization of nitrates by asparagus is in part enzymatic in nature.

G. T. Nightingale
L. G. Schermerhorn

N. J. Agricultural Experiment Station,
New Brunswick, New Jersey

1 Paper No. 296 of the Journal Series, New Jersey Agricultural Experiment Stations, Department of Horticulture.

2 Tanret, Georges, Compt. rend. 149: pp. 48–51 (1909). The asparagus plant contains no starch but contains an inulin-like polysaccharide, "asparagose," which upon hydrolysis yields 93 per cent. levulose and 7 per cent. glucose.

3 Lipman, C. B., and Taylor, J. K. "Do Green Plants have the Power of fixing Elementary Nitrogen from the Atmosphere?" *Jour.* Franklin Institute, Vol. 198, No. 4, pp. 475–507 (1924).